

Resistance of Three Tick Species Infesting Cattle and Camels to Cypermethrin in Alelafon, Khartoum State, Sudan

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ملخص البحث

أجريت هذه الدراسة لتقييم مدى مقاومة نوعين من القراد هما مروحية الرأس إفيرتسية الإفيرتسية والهيالوما الأناضولية اللذان تم جمعهما من الأبقار، ونوع هيالوما الإبل وحيدة السنام الذي جُمع من الإبل، لمبيد السيبيرميثرين باستعمال إختبار زُمرة البرقات. جُمع القراد لهذه الدراسة من منطقة العيلفون، حيث يستعمل مبيد السايبرميثرين بصورة مكثفة لمكافحة القراد. عوامل المقاومة (ع م) لهذه الأنواع من القراد كانت على النحو التالي: 18.92، 8.65 و 7.6 مرة، على التوالي، مما يُشير بأن أنواع القراد الثلاثة مقاومة لمبيد السايبرميثرين. أوضحت النتائج أيضاً بأن مروحية الرأس إفيرتسية الإفيرتسية هو النوع الأكثر مقاومة للسايبرميثرين يليها الهيالوما الأناضولية ثم هيالوما الإبل وحيدة السنام. قيمة مربع كاي (م ك) المنخفضة نسبياً لقراد مروحية الرأس إفيرتسية الإفيرتسية (12.29) بسبب مبيد السايبرميثرين تُشير إلى أن هذا النوع من القراد متجانس في مقاومته للمبيد، بينما كانت القيمة العالية ل م ك الناتجة من قراد الهيالوما الأناضولية وهيالوما الإبل وحيدة السنام (53 و 22.84 على التوالي) بسبب عدم تجانس أفراد هذين النوعين من القراد عندما تمت معاملتهما بمبيد السايبرميثرين.

Summary

This study was conducted to evaluate resistance status of *Rhipicephalus e. evertsi*, *Hyalomma anatolicum*, collected from cattle, and *Hyalomma dromedarii*, collected from camels, to cypermethrin using larval packet test. The ticks of the study were collected from Alelafon area, where cypermethrin was intensively used for tick control. The resistance factors (RF) of these tick species were 18.92, 8.65 and 7.6 folds, respectively, which indicate that the three tick species are resistant to cypermethrin. The results also show that *Rhipicephalus e. evertsi* is the most resistant tick species to cypermethrin followed by *Hyalomma anatolicum* and then *Hyalomma dromedarii*. The relatively low Chi Square (χ^2) value of *Rhipicephalus e. evertsi* (12.29) due to cypermethrin indicates that the population of this tick species is homogeneously resistant to the acaricide, while the high χ^2 values of *Hyalomma anatolicum* and *Hyalomma dromedarii* (53 and 22.84, respectively) are due to the heterogeneous resistance of these tick species populations to the cypermethrin.

Introduction

In the Sudan, ticks are responsible for much of the economic losses that occur in animals, especially foreign breeds (Elhaj and Hamid, 2003; Gamal and El Hussein, 2003; El Ghali and Hassan, 2012). Ticks threaten livestock industry not only through their role in transmitting fatal diseases, but also by direct damages, including loss of blood, decrease in weight gain and milk production, damage of hides and udders, and injection of toxins (Jongejan and Uilenberg, 2004).

Control of ticks and tick-borne diseases in Sudan is based mainly on the use of

chemical acaricides (Aziz, 2003). However, there is no official policy on tick control in the Sudan. Cypermethrin was registered for veterinary use in the Sudan in 1990. It has since become the predominantly acaricide used for ticks control in Khartoum State and other parts of the Sudan (Mohammed *et al.*, 1993). The development of resistance is a potential problem resulting from the over-use of any pesticide. Unfortunately, information concerning tick-resistance to this acaricide is limited although attempts to monitor tick resistance at the larval and other stages had been made (Razig and Osman, 1987; Mohammed, 2003).

Lately, in Alelafon area, the stock holders stated that, they were experiencing problems of tick control failures following using of cypermethrin. Consequently, this study was performed to provide significant and update information that can be used in tick control programmes in order to manage tick resistance problem.

Materials and Methods

Acaricides and solvents

Cypermethrin active ingredient (AI) technical grade of 94% purity (Jordan Insecticides and Agro-Treatment Manufacturing Co., Amman, Jordan), Trichloroethylene (BDH, London, England), and Al Wazir Olive Oil [Kobayter Brothers Company (Industrial & Commercial S.A.L) – Kalamoon, Lebanon] were used in this study.

Ticks and area of investigation

Fully engorged *Rhipicephalus e. evertsi* and *Hyalomma anatolicum* females were collected from cattle, while *Hyalomma dromedarii* engorged females were collected from camels. These ticks were collected from Alelafon; a small town located at Blue Nile east bank, Locality of Nile east, Khartoum State. The engorged female ticks were kept in an incubator at 27 ± 1 C° and 75-80 % RH. Active larvae from the first generation of each tick species were used (Mohammed *et al*, 1993; da Silveira-Novellino *et al.*, 2007).

Larval packet test (LPT)

The LPT was conducted as described by FAO (2004). Stock solution at a concentration of 0.2% was prepared by dissolving the cypermethrin in two parts of the trichloroethylene and one part of the olive oil. Nine serial concentrations (0.1, 0.05, .025, 0.0125, 0.00625, 0.003125, 0.001563, 0.000781, and 0.000391) were made from the stock solution. Control filter papers were prepared using diluents only. Three replicates of each concentration, including the control papers, were impregnated.

Probit regression analysis

Percentage mortalities of the test larvae were corrected using Abbott's formula (FAO, 2004). The results were analyzed using a probit regression analysis to estimate lethal concentrations which kill 50% and 99% of the tick larvae (LC₅₀, LC₉₉), resistance factor (RF) at LC₉₉ relative to Cypermethrin-recommended dose and Chi Squares (χ^2) for each tick species (FAO, 2004).

Results

The results of the present study demonstrated that the LC₅₀ and LC₉₉ values for *Rh. e. evertsi* were greater than those recorded for *H. anatolicum* and *H. dromedarii*. *H. dromedarii* scored the lowest LC₅₀ and LC₉₉ values (Table 1). The resistance factors at LC₉₉ showed that *Rh. E. evertsi* is the most resistant tick species to Cypermethrin followed by *H. anatolicum* and *H. dromedarii* (RF = 18.92, 8.65 and 7.6, folds respectively) (Table 1; Fig. 1).

H. anatolicum and *H. dromedarii* showed χ^2 values (53 and 22.84, respectively) higher than the tabulated one ($\chi^2 = 15.51$) due to Cypermethrin.

Discussion

Cypermethrin has been used for too long time to control ticks in the dairy farms in the Khartoum State. The information obtained in this study is that ticks have developed resistance to cypermethrin.

The resultant resistance factors, at LC₉₉ level of mortality for the three tick species show different degrees of these tick species resistance to cypermethrin. The high level of resistance detected in the three tick species (RF= 7.60, 8.65, 18.92 folds higher than the recommended dose) suggests that failure of this acaricide in tick control in the area of study is due to resistance.

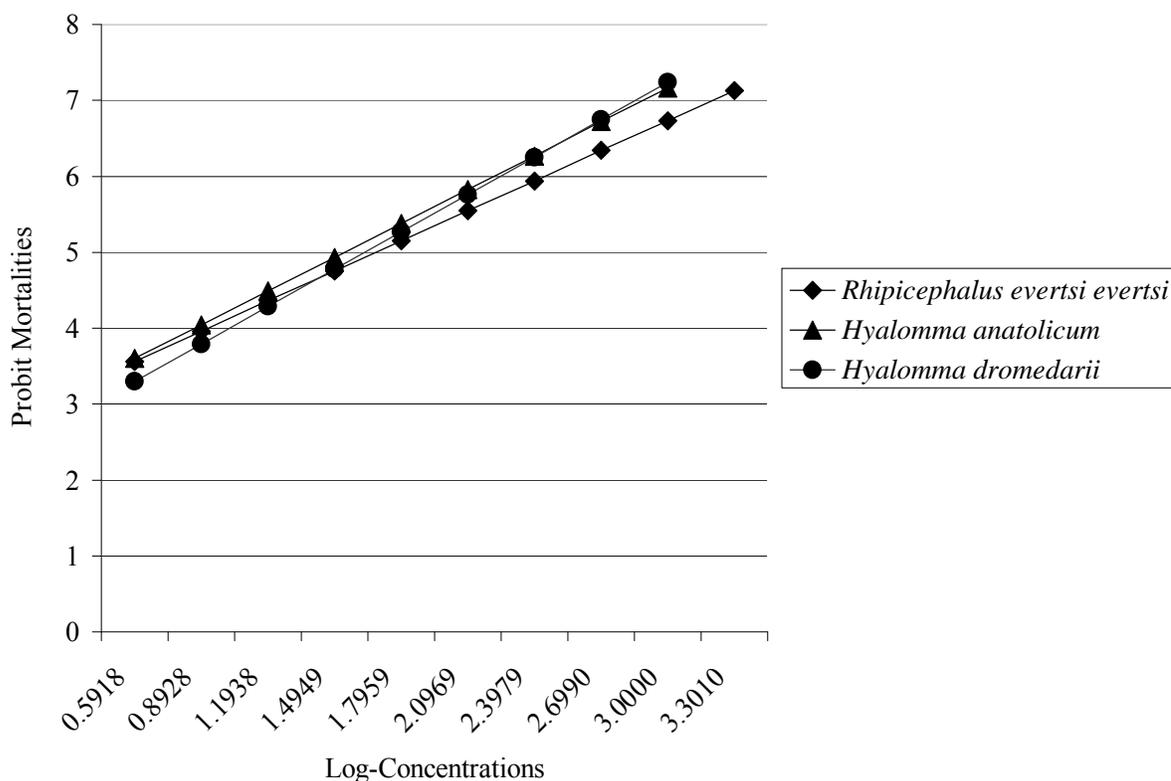
The RF can also be calculated as a proportion between LC₉₉ values of the field populations in relation to the recommended dose (Enayati *et al*, 2010).

Table 1. LC₅₀, LC₉₉ values with their 95% confidence limits, resistance factors and Chi Square values of the three tick species when tested with Cypermethrin

Tick species	LC ₅₀	CL of LC ₅₀ (95%)	LC ₉₉	CL of LC ₉₉ (95%)	RF _{99r}	χ^2
<i>H. anatolicum</i>	0.00345	0.003402-0.003458	0.129800	0.127728-0.131984	8.65	53
<i>H. dromedarii</i>	0.00427	0.004235-0.004309	0.113948	0.112960-0.114944	7.60	22.84
<i>Rh. e. evertsi</i>	0.00481	0.004761-0.004872	0.28386	0.280595-0.287179	18.92	12.29

CL (95%) \equiv of the confidence limits at 95% level of significance

RF_{99r} \equiv resistance factor at LC₉₉ relative to the dose of Cypermethrin recommended by the manufacturer

**Fig. 1: Regression lines showing the response of the three tick species that treated with Cypermethrin**

Beugnet and Chardonnet (1995) have reported that a RF value of $P > 5$ is indicative of a resistant population. According to the classification of resistance factors suggested by Mendes *et al* (2007), the three tick species are considered resistant level II to cypermethrin. *H. anatolicum* and *H. dromedarii* revealed χ^2 values higher than the expected tabulated χ^2 value due to cypermethrin. This indicates that the populations of these tick species are mixture of susceptible and resistant individuals. The low χ^2 value of

Rh. E. evertsi relative to the tabulated value confirms that the population is acting homogenously when exposed to cypermethrin and is considered to be pure resistant strain (Mohammed, 2003; FAO, 2004).

By comparing the resistance factors of the three tick species, *Rh. e. evertsi* was found the most resistant tick species to cypermethrin followed by *H. anatolicum* and *H. dromedarii*. *Rh. e. evertsi* is a two-host tick and remains on-host for time longer than *H. anatolicum*

and *H. dromedarii* which are three-host ticks (Wharton and Roulston, 1970). The life cycle of *H. dromedarii* may take longer time than the other two cattle ticks because of the movement of the nomads. The long life cycle could also be a contributory factor which protects the ticks from exposure to chemicals (Shyma, et al 2012). The above findings show high levels of resistance to cypermethrin in the test tick species. Therefore, it is recommended to use an alternative acaricide to control ticks in the area of study.

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